1. (20 pts) **Concepts and Models.** Briefly identify and define the following terms (5 pts. each, 2-5 sentences).

    a. Pareto superior move

    b. Niskanen model of bureaucracy

    c. Neutral tax

    d. Ramsey tax

    e. Fiscal illusion

2. (15 pts.) **Game Theoretic Representation of an Externality Problem.**

   a. At the bottom of this page, construct a two-person, three-strategy game matrix that illustrates the problem associated with activities that generate negative externalities. Label all details and in the space below very briefly describe the nature of the dilemma.

   b. Now introduce a conditional **tax (or fine**) that is sufficient to solve the problem. Demonstrate that after the fine is imposed the new Nash equilibrium is Pareto efficient. Again, label all important details.

   c. What is the smallest tax (or fine) that can be imposed on the externality generating activity that is sufficient to solve the problem? Briefly explain your reasoning.

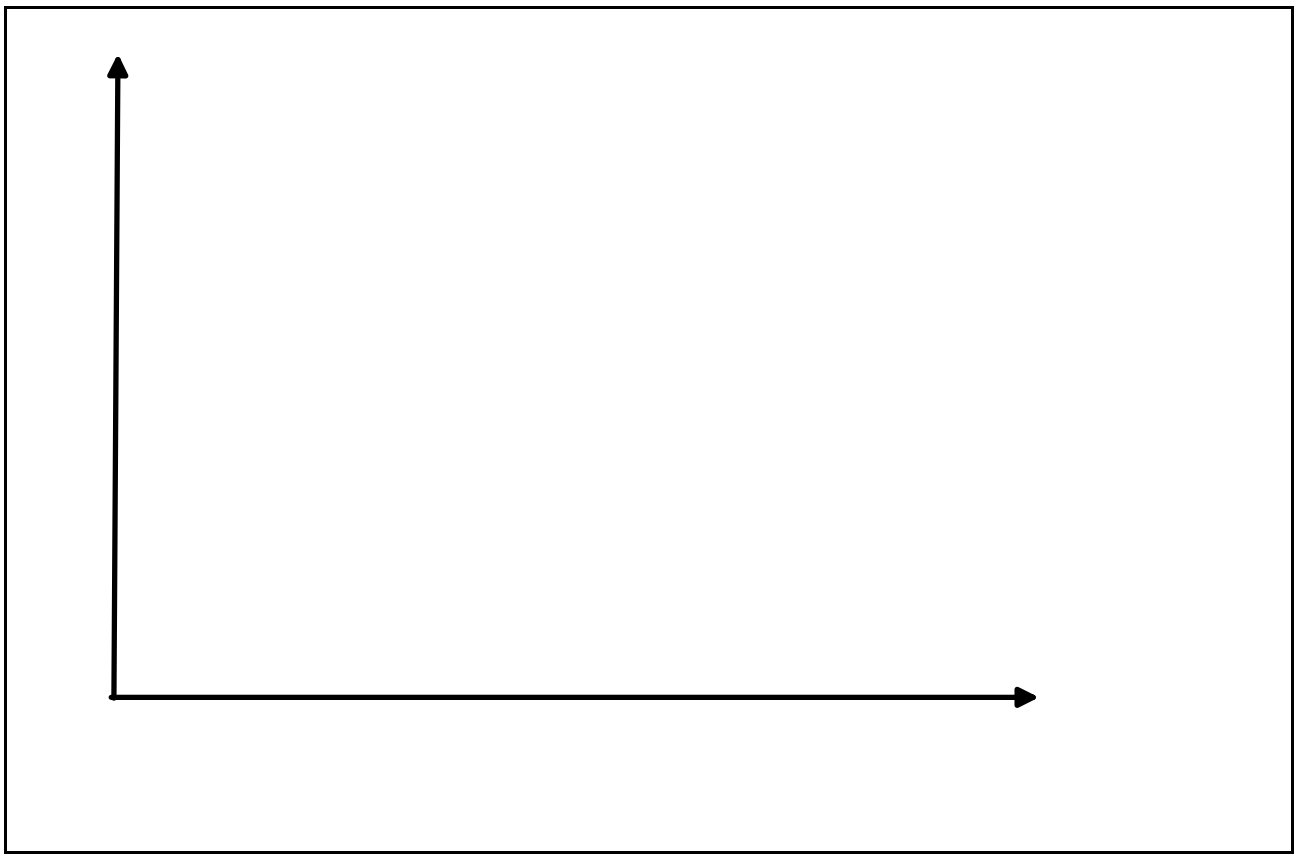
d. .

3. (20 pts.) **Geometry of public goods problems, ideal government provision and finance, and democratic politics**.

   a. In the figure below, depict a public goods problem with three different people. Characterize all relevant details. Explain why a problem exists.

   b. Now depict the ideal government provision of the service funded with Lindahl taxes. Again label and briefly explain all relevant details.

   c. Does the median voter in your diagram prefer the free rider situation to public provision with a Lindahl tax? Demonstrate, and briefly explain why or why not?



4. (20 pts.) **The Algebra of Free Rider Problems.** Suppose that Al's marginal benefit curve for a pure public good is $MB_a = 400 - 2Q$ and Bob's MB curve is $MB_b = 200 - Q$. Suppose that the public good (shoveling snow off sidewalks) can be produced at constant average cost, with $MC = 200$.

   a. Find the "high demander" output of the pure public good.

   b. Find the Pareto optimal level of this local public good.

   c. Determine the Pigovian subsidy rate that can induce Al to produce the Pareto optimal level of the local public good.

   d. Depict your results in a diagram, and label all details.

5. (25 pts.) **The Calculus of Regulatory Externalities.** Suppose that two adjacent communities adopt environmental regulations for water pollution that affect both communities (as with respect to "fracking"). Suppose that the government of each community attempts to maximize the net benefits realized by its own median voter, whose net benefits can be characterized as $N_i = B_i - C_i$, with $i = 1, 2$. Suppose that $B_i = b(W_1 + W_2)$ with $B_{i_W} < 0$. The water pollution generated in community i, W_i, is controlled through regulation R_i, so $W_i = w(R_i)$, with $W_{i_R} < 0$. Regulations, unfortunately, are costly to implement, $C_i = c(R_i)$, with $C_R > 0$.

   a. Characterize the best reply function for each government's regulations.

   b. Characterize the Nash-equilibrium regulations for the two communities mathematically and explain your result.

   c. Show that the outcome is not Pareto efficient (Hint: show that the combination of regulations fails to maximize total net benefits.)

   d. Discuss two methods through which this regulatory externality problem be solved. (1 paragraph).